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COMPARATIVE VALUES OF TYPES OF ANTI-HOG-CHOLERA SERUM

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CHARACTER OF ANTI-HOG-CHOLERA SERUM

It is generally known to those interested in the swine industry that hogs can be immunized against cholera if they are treated properly with potent anti-hog-cholera serum and hog-cholera virus. It is not so well known that methods of preparing this serum have undergone such a change in recent years that three different types of the product now are available on the market.

Anti-hog-cholera serum produced by commercial establishments according to the original methods of Dorset, McBryde, and Niles contains the red cells of the blood, which makes very careful handling necessary to prevent spoiling. It can not be heated as can a clear serum, and experience has demonstrated the need for a purer and more refined product. In 1917, Dorset and Henley of the Bureau of Animal Industry succeeded in developing methods for separating the protective serum from the cells, thus making it commercially practicable to use only the true serum or protective portion of hyperimmune blood in serum production and to eliminate the inert and nonprotective cells. Two types of clear or refined serum now are marketed commercially, and the relative values of these will be explained. Swine owners whose herds are treated pay the entire cost of serum production, distribution, and immunization; therefore they as well as practicing veterinarians should know how to determine whether the best and cheapest product is being used.

Producers of viruses, serums, toxins, and similar products for veterinary use and shipment outside of the State where prepared, under the virus-serum-toxin law of 1913, are required to hold a license from the Secretary of Agriculture and to prepare their products in compliance with regulations promulgated under this law.

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Enforcement of the law and regulations is directed by the Division of Virus-Serum Control of the Bureau of Animal Industry. Producing establishments are supervised by inspectors of the bureau, whose duty it is to see that only suitable animals are used in the preparation of veterinary biologic products and that these products are prepared in accordance with Bureau of Animal Industry regulations.

DESCRIPTION OF TYPES OF ANTI-HOG-CHOLERA SERUM

DEFIBRINATED-BLOOD SERUM

Anti-hog-cholera serum as originally prepared consists of defibrinated hyperimmune blood and a solution of carbolic acid, which is added to prevent the product from spoiling. For many years it was the only type of serum available for the prevention of cholera. It is sometimes referred to as "ordinary serum," "whole-blood serum," "bloody serum," etc., but the name "defibrinated-blood serum" will be used here. The true or protective serum content of defibrinated-blood serum constitutes about 65 per cent of the product, while the remaining 35 per cent is nonprotective (25 per cent cells and 10 per cent preserving solution). The source of all anti-hog-cholera serum is the blood of hogs which have been made hyperimmune or overimmune to hog cholera by injecting into their blood streams large quantities of defibrinated blood taken from young pigs very sick of cholera. Several days after this treatment, which generates protective substances that are antagonistic to cholera, blood is taken from these hyperimmune hogs in large quantities and used in serum production.

CLEAR OR REFINED SERUM

In producing clear serum according to the method of Dorset and Henley hyperimmune blood is treated with certain harmless materials in solution to aid in separating the clear protective serum from the cells. This solution of hyperimmune blood and clarifying materials then is passed through a separator or centrifuge to effect separation much the same as cream is separated from milk. The clear portion when preserved is now known commercially as clear, refined, anti-hog-cholera serum. In the process of separation the clarifying solutions can not be eliminated and are retained in the completed product. These solutions with preserving solution dilute the serum but otherwise are without effect. The product may be marketed in this form or have added to it a quantity of sterile normal salt solution containing carbolic acid, the volume of which is equal to that lost by removing the blood cells. The latter practice has resulted in the marketing of two types of clear serum described in the two following paragraphs:

CLEAR, UNCONCENTRATED SERUM

This type of serum contains sterile normal salt solution which is added to take the place of blood cells in defibrinated-blood serum. The product carries the same protection as does defibrinated-blood serum in like quantities but is diluted in comparison to clear, concentrated serum. It therefore likewise contains 65 per cent of true or protective serum while 35 per cent of the product is nonprotective (25 per cent diluent with clarifying solutions and 10 per cent preserving solution). It sometimes is referred to as "filled serum," "dilute serum," and the like, but the name "unconcentrated serum" is used here.

CLEAR, CONCENTRATED SERUM

The volume lost by removing the blood cells is not replaced in this type of clear serum; therefore, the protective part constitutes a much greater percentage of the whole than it does in other serums. Its protective part represents over 80 per cent (four-fifths) of the whole, while its nonprotective part is less than 20 per cent (one-fifth). For these reasons it is regarded as concentrated in comparison to other cholera serums. In view of the high precentage of protective serum in the clear, concentrated serum, the Bureau of Animal Industry permits it to be recommended for use in doses smaller than those required for either of the other serums.

TYPES OF CLEAR SERUM COMPARED

Figure 1 portrays 2,400 c. c. of concentrated serum, a quantity sufficient to treat a herd of 100 pigs with 24 c. c. each. To hold such a quantity of serum would require 4⅘ bottles of 500 c. c. capacity each, the size in which the product commonly is marketed. The figure shows likewise 3,000 c. c. of unconcentrated serum, which also is adequate to treat a herd of 100 pigs with 30 c. c. each, but requires 6 bottles of 500 c. c. capacity to hold the entire quantity.

Each of the serums compared in these illustrations contains an equal quantity of true or protective serum and therefore should cost the same, all things being equal. In each case the true or protective serum amounts to 1,950 c. c. Twenty-four hundred cubic centimeters of concentrated serum at $1.05 per 100 c. c. amounts to $25.20; thus it is worth $1.29 per 100 c. c. of true serum ($25.20÷1,950 c. c. ×100=$1.29). Three thousand cubic centimeters of unconcentrated serum at 84 cents per 100 c. c. makes this entire quantity also worth $25.20, and therefore its true serum likewise is worth $1.29 per 100 c. c. The 2,400 c. c. of concentrated serum in the illustration became 3,000 c. c. of unconcentrated serum simply by the addition of 600 c. c. of diluent (sterile normal salt solution containing one-half of 1 per cent carbolic acid). Thus the nonprotective part is changed from 450 c. c. in the first instance to 1,050 c. c. in the other, with no increase whatever in the intrinsic value of the product.

RELATIONSHIP OF PROTECTIVE SERUM TO VALUES

The intrinsic value of the two types of clear serum is based on their actual protective-serum content and the relative commercial worth of each varies in the same ratio. In practice, however, it frequently happens that the market price does not accord with their respective intrinsic values.

Concentrated serum always is higher in price per 100 c. c. than the unconcentrated product, but the protective part may actually be cheaper. For example, if concentrated serum were quoted at $1.05 per 100 c. c., the unconcentrated product would be worth only 84 cents, or 80 per cent of the price of the concentrated. Therefore, if unconcentrated serum were priced at more than 84 cents per 100 c. c., it would be more expensive than the concentrated product at the price stated. When the smaller volume is administered, charges for immunization likewise may be reduced wherever it is the custom to base such charges on the quantity of serum administered. The smaller volume also may be marketed with less expense to the producer because, as shown in Figures 1 and 2, a given number of doses

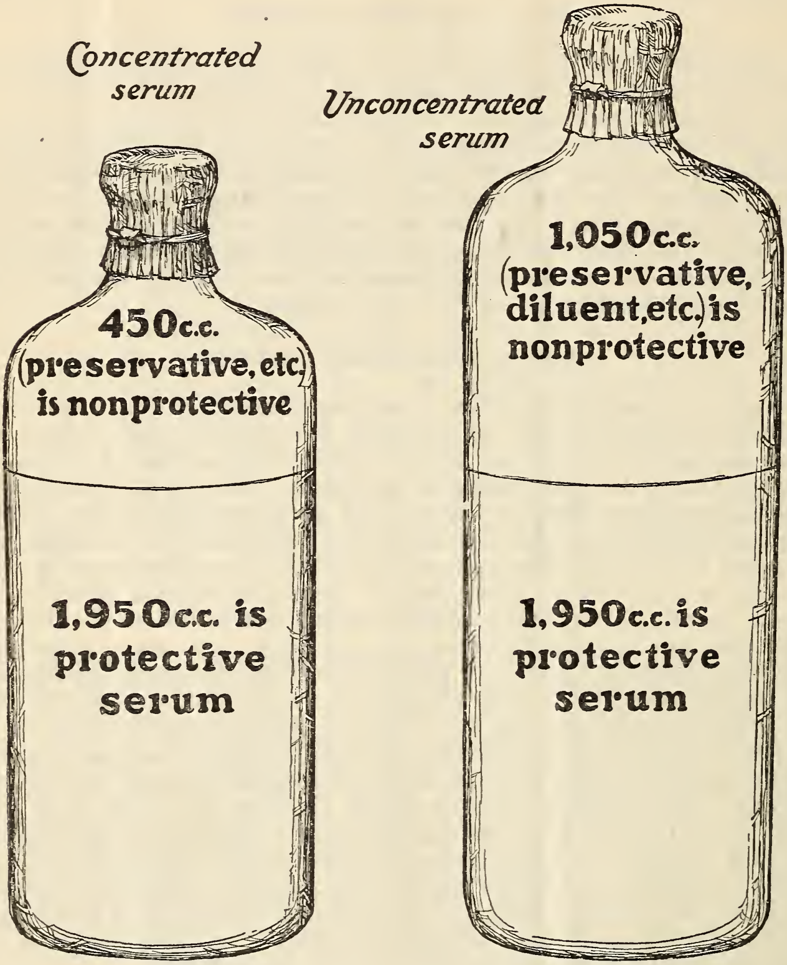
Concentrated serum
450c.c. (preservative, etc.) is nonprotective
1,950c.c. is protective serum
Unconcentrated serum
1,050c.c. (preservative, diluent, etc.) is nonprotective
1,950c.c. is protective serum

FIG. 1.—A comparison of the minimum quantities of clear, concentrated serum and clear, unconcentrated serum required to immunize 100 pigs, each weighing 40 pounds. Note that the protective-serum content of each bottle is the same. The cost of serum should always be considered in terms of its protective-serum content

can be marketed in fewer bottles than are required for the more bulky products. As a result less should be paid for bottles, packing, labeling, express charges, and the like.

It should be appreciated that it is more expensive to produce clear serum of either type from a given quantity of blood than it is to produce defibrinated-blood serum, but the advantages gained through the elimination of inert and crude materials are worth a reasonable difference in price. It is noteworthy, too, that the market price for concentrated serum per 100 c. c. usually has been but a few cents above the price quoted for defibrinated-blood serum when allowance is made for the number of protective doses each contains.

Table 1 illustrates the value of each type of clear serum as compared to the other.

TABLE 1.—*Relative value per 100 c. c. of concentrated and unconcentrated serum*

Concentrated serum (1.25 times value of unconcentrated)	Unconcentrated serum (0.80 times value of concentrated)	Concentrated serum (1.25 times value of unconcentrated)	Unconcentrated serum (0.80 times value of concentrated)
$0.90	$0.72	$1.10	$0.88
.95	.76	1.15	.92
1.00	.80	1.20	.96
1.05	.84		

The following simple method may be used to determine the relative monetary value of either product when the price of the other is known.

1. Multiply the price quoted per 100 c. c. of unconcentrated serum by 1.25 to determine the relative value of 100 c. c. of concentrated serum. Example showing that when unconcentrated serum sells at 84 cents the concentrated is worth $1.05 (0.84×1.25=$1.05).

2. Multiply the price quoted for concentrated serum by 0.80 to determine the relative value of unconcentrated serum. Example showing the reverse of No. 1 (1.05×0.80=$0.84).

HOW TO DISTINGUISH THE DIFFERENT TYPES OF SERUM

All immediate or true containers of serum prepared under the supervision of the Bureau of Animal Industry must bear approved trade labels. There are several distinguishing features which are required to be a part of each label, and these should serve to acquaint the user with the type of serum before him. Each trade label must bear the true name of the product in large type. All types of serum are labeled "anti-hog-cholera serum," but descriptive words are included to identify the clear and refined product as such. In addition it is required that immediately following the true name there must be shown the quantity of serum in each bottle and the per cent of true or protective serum contained in the quantity given. This statement for containers of 500 c. c. capacity appears in one of the following forms, depending upon the type of product concerned:

"Quantity, 500 c. c., containing 65 per cent protective serum," or
"Quantity, 500 c. c., containing 80 per cent protective serum."

Labels also bear a date after which it is not recommended that the product be used. For defibrinated-blood serum and unconcentrated serum this date is limited to two years after the date on which the product is prepared, but on account of the high quality of concentrated serum a three-year date is permitted for it.

Serum and virus are prepared in batches. Each batch consists of blood collected from many animals and is numbered for identification. On the label of each container a number appears which identifies it with the batch of which it is a part. If the label of each container of serum is examined, these features serve to show the type and batch of product involved and should enable one to decide which is preferred when the character of the different serums and their values are considered.

It is very desirable that some means be used to identify each container of serum and virus prepared under the supervision of bureau employees and through which the user of these products may be enabled to identify those so prepared as distinguished from those not prepared under supervision. Therefore, producers are permitted to use approved caps and metal seals to effect the desired identification. The seals are furnished by the bureau and bear the letters, "U. S." The caps are marked "U. S. Released," and bear the license number of the producer. No other means of identification has been found so effective and satisfactory as this, but it should not be taken as an absolute guaranty of the potency and purity of the products. It means that products so marked have been prepared and tested as required by the Bureau of Animal Industry and that they were found to be satisfactory when thus tested.

MINIMUM DOSES PERMITTED

Table 2 shows the minimum doses of serum which the bureau permits to be recommended for each type of cholera serum. Larger doses should be given when conditions are unfavorable in any way. Inasmuch as 80 c. c. of concentrated serum is equivalent to 100 c. c. of either defibrinated-blood serum or unconcentrated serum, the dose permitted is always 80 per cent or four-fifths of that required for the last two products. Likewise doses required in each instance for unconcentrated and defibrinated-blood serums are 25 per cent or one-fourth larger than those for concentrated serum.

TABLE 2.—*Minimum doses of the three types of serum*

Size of animal	Concentrated serum	Unconcentrated serum	Defibrinated-blood serum
	Dose, c. c.	*Dose, c. c.*	*Dose, c. c.*
Suckling pigs	16	20	20
Pigs 20 to 40 pounds	24	30	30
Pigs 40 to 90 pounds	28	35	35
Pigs 90 to 120 pounds	36	45	45
Hogs 120 to 150 pounds	44	55	55
Hogs 150 to 180 pounds	52	65	65
Hogs 180 pounds and over	60	75	75

COST OF IMMUNIZATION LOWEST WHEN PIGS ARE YOUNG

A herd of hogs can be immunized most cheaply when the animals are less than 8 weeks old, as the cost for serum increases with the size of pigs treated. Figure 2 illustrates the difference in the quantity of concentrated serum required for a healthy young pig weighing 40 pounds and for a half-grown one weighing approximately 120 pounds. A healthy herd of 100 of the younger pigs would require 2,400 c. c. of concentrated serum, or 4⅘ bottles of 500 c. c. capacity, whereas the same number of 120-pound pigs would require 3,600 c. c., or 7⅕ bottles. A dose of 24 c. c. is adequate for each of the younger pigs, whereas it requires a dose of 36 c. c. for each of the older pigs. At $1.05 per 100 c. c. it will cost $25.20 for the serum in the first instance, which amounts to only about 1 per cent of the prospective value of the pigs when marketed, or only 25 cents per pig. At the same price for serum it would cost $37.80 or 38 cents per pig for serum to treat the larger animals, which is an increase of 50 per cent in the cost for serum and amounts to approximately 1.5 per cent of the prospective market value.

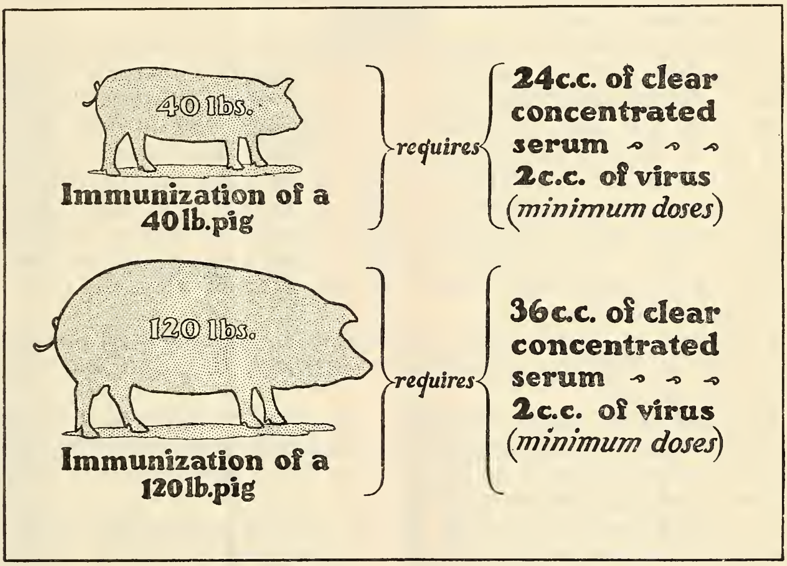
40 lbs.
Immunization of a 40 lb. pig
requires
24 c.c. of clear concentrated serum
2 c.c. of virus
(minimum doses)
120 lbs.
Immunization of a 120 lb. pig
requires
36 c.c. of clear concentrated serum
2 c.c. of virus
(minimum doses)

FIG. 2.—To immunize a pig after it is half grown requires 50 per cent more serum than when it is young. Besides, young pigs are more easily handled

Another important consideration is that the young pigs are protected against cholera for practically their entire life period, whereas in later immunization the protection is for a smaller percentage of this period. The expense of administering treatment aside from the cost of serum also is considerably greater for large animals than for young pigs.

SUMMARY

Anti-hog-cholera serum and virus when properly prepared and administered will immunize against hog cholera. These products when produced by licensed establishments are prepared and tested under the supervision of Bureau of Animal Industry employees in accordance with regulations promulgated under authority contained in the virus-serum-toxin law of 1913.

There are three types of anti-hog-cholera serum available to the purchaser, namely, defibrinated-blood serum, clear, unconcentrated serum, and clear, concentrated serum, the intrinsic values of which are dependent upon the quality and quantity of true or protective serum present in each.

Concentrated serum contains over 80 per cent of protective serum, and therefore is 25 per cent more valuable than other types of cholera serum. Defibrinated-blood serum and unconcentrated serum each contains 65 per cent of protective serum, and each is only 80 per cent as valuable as the concentrated product. This means that 100 c. c. of the former is equal to 125 c. c. of the latter and vice versa.

The immunizing properties and hence the intrinsic value of each type of serum are in direct ratio to the quantity of true or protective serum in each. The simple rules given may be used by any one to determine the comparative value of each product when the price of the other is known.

The minimum doses which establishments are permitted to recommend for the different types of serum all have the same quantity of protective serum.

Elimination of the blood cells in the clear, concentrated product not only makes its heating practicable and improves its keeping qualities but reduces its bulk, and thus makes it the most satisfactory type of serum for hog-cholera prevention.

In recognition of the high quality of the concentrated type of serum a three-year return date for it is permissible, whereas this date is limited to two years for the other serums.

By examining the label of each container of serum one can readily determine the type. These labels for defibrinated-blood serum and unconcentrated serum indicate that each of these types contains 65 per cent of protective serum, whereas for the concentrated product the proportion of protective serum is 80 per cent.

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